# ST. VINCENT PALLOTTI COLLEGE OF ENGINEERING & TECHNOLOGY, NAGPUR

(An autonomous institution affiliated to Rashtrasant Tukadoji Maharaj Nagpur University)

## M.Tech. Scheme of Examination & Syllabus 2025-26

## STRUCTURAL ENGINEERING

**SEMESTER III**

| Sr. No. | Course Category | Course Code | Course Title | Hours per Week | | | Credits | Maximum Marks | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | L | T | P | | Continual Assessment | End Sem Examination | Minimum Passing Marks | Total |
| 1 | PEC | 25SE301T | Program Elective - III (Refer PE Basket) | 4 | - | - | 4 | 40 | 60 | 50 | 100 |
| 2 | PEC | 25SE302T | Program Elective - IV (Refer PE Basket) | 4 | - | - | 4 | 40 | 60 | 50 | 100 |
| 3 | PROJ | 25SE303P | Project Phase - I | - | - | 16 | 8 | 100 | 100 | 100 | 200 |
| **Total** | | | | **8** | **-** | **16** | **16** | **180** | **220** | **-** | **400** |

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| | | July 2026 | 1.0 | Applicable for 2026-27 |
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## M.Tech. Scheme of Examination & Syllabus 2025-26

## STRUCTURAL ENGINEERING

**SEMESTER IV**

| Sr. No. | Course Category | Course Code | Course Title | Hours per Week | | | Credits | Maximum Marks | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | L | T | P | | Continual Assessment | End Sem Examination | Minimum Passing Marks | Total |
| 1 | PROJ | 25SE401P | Project Phase – II OR Project based Internship | - | - | 32 | 16 | 300 | 100 | 200 | 400 |
| **Total** | | | | **8** | **-** | **16** | **-** | **300** | **100** | **200** | **400** |

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| Semester | Hours per Week | | | Credits | Maximum Marks | | |
|---|---|---|---|---|---|---|---|
| | L | T | P | | Continual Assessment | End Sem Examination | Total |
| First Semester | 20 | - | 8 | 24 | 250 | 350 | 600 |
| Second Semester | 20 | - | 8 | 24 | 250 | 350 | 600 |
| Third Semester | 8 | - | 16 | 16 | 130 | 170 | 300 |
| Fourth Semester | - | - | 32 | 16 | 100 | 100 | 200 |
| Total | 48 | - | 64 | 80 | 730 | 970 | 1700 |

## Basket for Program Elective

| Semester | Course Category | Course Code | Name of Course | Credits |
|---|---|---|---|---|
| I | PEC | 25SE105T(i)<br>25SE105T(ii)<br>25SE105T(iii) | Theory of Elasticity & Elastic Stability<br>Advanced Steel Structures<br>Design of Environmental Structures | 4 |
| II | PEC | 25SE205T(i)<br>25SE205T(ii)<br>25SE205T(iii) | Design of High Rise Structures<br>Bridge Engineering<br>Advanced Earthquake Design | 4 |
| III | PEC | 25SE301T(i)<br>25SE301T(ii)<br>25SE301T(iii) | Advanced Foundation Design<br>Structural Health Monitoring<br>Retrofitting and Rehabilitation of Structures | 4 |
| III | PEC | 25SE302T(i)<br>25SE302T(ii)<br>25SE302T(iii) | Sustainable Construction and Demolition Engineering<br>Theory of Plates and Shells<br>Smart Structures and Application | 4 |

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## THIRD SEMESTER

| Course Code | Course Name | Th | Tu | Pr | Credits | Evaluation | | |
|---|---|---|---|---|---|---|---|---|
| | | | | | | CA | ESE | Total |
| 25SE301T(i) | PE – III Advance Foundation Design | 4 | - | - | 4 | 40 | 60 | 100 |

| Course Objectives | Course Outcomes |
|---|---|
| 1. To introduce various aspects of foundation engineering along with bringing out the advanced theories and practical knowledge of the subject<br>2. To develop an ability and skill to apply the codal provisions for the design of various types of foundation<br>3. To develop an ability and skill to design various aspects of foundation engineering including soil exploration, details of shallow and deep foundations | At the end of the course, students will be able to:<br>1. Understand various Bearing Capacity Theories.<br>2. Select and design shallow foundation satisfying bearing capacity and settlement requirements<br>3. Design pile foundation satisfying bearing capacity and settlement requirements<br>4. Understand the engineering behavior of well Foundations and their design aspects<br>5. Understand the engineering behavior of expansive soils and selection of suitable foundation type for such soils |

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| Unit I | [9 Hrs] |
| Bearing Capacity Theories- Bearing capacity theories (Terzaghi's, Meyerhoff's, Hansen's, Vesic's, Balla's)- foundations subjected to centric vertical loads, inclined loads, eccentric loads, foundations on layered soils, anisotropic soils, foundations on slopes, over voids, interference of footings. | |
| Unit II | [9 Hrs] |
| Shallow Foundations-Settlement analysis- components of settlement, elastic settlement, flexible and rigid footings, contact pressure distribution, prediction of elastic parameters from SPT, CPT and other field tests, consolidation settlement, differential settlement. Design of individual footings, strip footing, combined footing, rigid and flexible mat, buoyancy raft, basement raft, underpinning. | |
| Unit III | [9 Hrs] |
| Pile Foundations- Estimation of load carrying capacity of single and pile group under various loading conditions. Pile load testing (static, dynamic methods and data interpretation), settlement of pile foundation, code provisions, design of single pile and pile groups, and pile caps. Load transfer mechanism, Pile capacity in various soil types, negative skin friction, group action, settlements, laterally loaded vertical piles, pile foundations on rocks. | |
| Unit IV | [9 Hrs] |
| Well Foundations- Types, components, construction methods, design methods (Terzaghi, IS and IRC approaches), check for stability, base pressure, side pressure and deflection. | |
| Unit V | [9 Hrs] |
| SPECIAL TOPICS- Foundations on difficult sub-soils (collapsible and expansive soils) - Foundations for tall structures. | |

**Text Books**

| S.N | Title | Authors | Edition | Publisher |
|---|---|---|---|---|
| 1 | Foundation Analysis and Design | Bowles. J.E. | Edition, 5th Edn, 1997 | Tata McGraw-Hill International |
| 2 | Shallow Foundations: Bearing capacity and settlement | Das B.M. | - | CRC Press, 1999 |
| 3 | Pile Foundations in Engineering Practice | Prakash, S. and Sharma, H.D. | - | John Wiley & Sons Inc., 1990. |

Reference Books

| S.N | Title | Authors | Edition | Publisher |
|---|---|---|---|---|
| 1 | Foundation Design | Teng, W.C. | - | Prentice-Hall of India (Pvt) Ltd., 1965 |
| 2 | Design of Foundation Systems - Principles and Practices | Kurian, N.P. | 2nd Edn. 1994 | Narosa Publishing House |

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## THIRD SEMESTER

| Course Code | Course Name | Th | Tu | Pr | Credits | Evaluation | | |
|---|---|---|---|---|---|---|---|---|
| | | | | | | CA | ESE | Total |
| 25SE301T(ii) | PE – III Structural Health Monitoring | 4 | - | - | 4 | 40 | 60 | 100 |

| Course Objectives | Course Outcomes |
|---|---|
| 1. To understand the structural health monitoring for structures.<br>2. To understand the conditional assessment & techniques for strengthening and retrofitting of structures. | The students will be able to<br>1. Understand the fundamentals of structural dynamic<br>2. Analyze the need and challenges of Structural Health Monitoring<br>3. Describe various methods of damage detection<br>4. Apply the Structural Health Monitoring technique for building.<br>5. Apply the Structural Health Monitoring techniques for bridge. |

| | |
|---|---|
| **Unit I** | **[8 Hrs]** |
| **Non-Destructive Evaluations** : - Concrete strength assessment –Rebound hammer test – Ultrasonic pulse velocity tests, penetration resistance, pullout tests, core sampling and testing, chemical tests – carbonation, chloride, content and corrosion problem. | |
| **Unit II** | **[8 Hrs]** |
| **Introduction to Structural Health Monitoring:** Factors affecting the health of structures, SHM scheme, various steps in SHM, damage diagnostic methods, challenges in SHM, Experimental modal analysis, operational modal analysis and combined methods | |
| **Unit III** | **[7 Hrs]** |
| **Methods of Damage Detection**: Vibration Control & SHM Damage Diagnostic methods based on vibration response, Method based on modal frequency/shape/damping, Curvature and flexibility method, Modal strain energy method, Sensitivity method, Baseline-free method. | |
| **Unit IV** | **[7 Hrs]** |
| **Health Monitoring Systems of Building Structures**: Numerical modeling– Use of sensors – Data acquisition techniques – Data Processing – Diagnostic techniques – Wireless sensor network – Rehabilitation techniques. | |
| **Unit V** | **[8 Hrs]** |
| **Health Monitoring of Bridges**: Measurement of Parameters, Sensors/Transducers technologies, Measurement & Health monitoring Techniques: Vibration signal analysis, Strain gage based Instrumentation, Destructive & Non-destructive testing, Load Test, etc | |

**Text Books**

| S.N | Title | Authors | Edition | Publisher |
|---|---|---|---|---|
| 1 | Structural Health Monitoring: A Machine Learning Perspective | Charles R Farrar, and Keith Worden, | first edition, 2012-2013. | John Wiley &Sons , |
| 2 | Structural health monitoring using smart sensors, Newmark Structural Engineering at Urbana | Nagayama, T. and Spencer Jr, B.F. | first edition,2007 | Laboratory.University of Illinois |

**Reference Books**

| S.N | Title | Authors | Edition | Publisher |
|---|---|---|---|---|
| 1 | Fibre optic methods for structural health monitoring | Glisic, B. and Inaudi, D. | first edition,2008 | John Wiley &Sons |
| 2 | Passive and active sensing technologies for structural health monitoring | Do, R. | first edition,2014 | University of California, San Diego. |

**THIRD SEMESTER**

| Course Code | Course Name | Th | Tu | Pr | Credits | Evaluation | | |
|---|---|---|---|---|---|---|---|---|
| | | | | | | CA | ESE | Total |
| 25SE301T(iii) | PE - III Retrofitting and Rehabilitation of Structures | 4 | - | - | 4 | 40 | 60 | 100 |

| Course Objectives | Course Outcomes |
|---|---|
| 1. To understand causes of distress and deterioration in structures.<br>2. To learn condition assessment using NDT and destructive testing methods.<br>3. To evaluate structural properties and damage in structures.<br>4. To study repair materials and rehabilitation techniques.<br>5. To select suitable retrofitting and strengthening methods for structures. | At the end of the course, students will be able to:<br>1. Estimate causes for distress and deterioration of structures.<br>2. Explain NDT techniques for condition assessment of structures for identifying damages in structures.<br>3. Evaluate structural properties.<br>4. Select repair material and identify a suitable repair option.<br>5. Select retrofitting strategy suitable for distress and formulate guide lines for repair management of deteriorated structures. |

| **Unit I** | **[9 Hrs]** |
|---|---|
| INTRODUCTION: An overview of present repair practices, distress identification and repair management, Causes of distress in concrete structures-Holistic Models for deterioration of concrete, Permeability of concrete, aggressive chemical agents, durability aspects, Condition SurveyDefinition, objectives, different stages-Preliminary inspection, planning stage, visual inspection, field laboratory testing stage, consideration for repair strategy | |
| **Unit II** | **[9 Hrs]** |
| NON DESTRUCTIVE AND DESTRUCTIVE TESTING METHODS: Non-Destructive evaluation tests - Concrete strength assessment - Rebound hammer test - Ultrasonic pulse velocity tests, penetration resistance, pull out tests, core sampling and testing, Chemical tests - Carbonation tests and chloride content, Corrosion potential assessment, half cell potentiometer test, resistivity measurement, Identification and estimation of damage. | |
| **Unit III** | **[9 Hrs]** |
| EVALUATION OF STRUCTURAL PROPERTIES: Fire damage assessment, structural integrity and soundness assessment, interpretation and evaluation of results, Evaluation of reserve strength of existing structures, analysis necessary to identify critical sections, active and passive repairs, modeling of repaired composite structures | |
| **Unit IV** | **[9 Hrs]** |
| REPAIR MATERIALS AND CASE STUDIES: Selection of repair materials for concrete-Essential parameters for repair materials-Strength and durability aspects, cost and suitability aspects, Materials for repair. Discussion of case studies- RCC buildings, water tanks, industrial structures-Identifying a suitable repair option for certain damage in a structure. | |
| **Unit V** | **[9 Hrs]** |
| REPAIR/ REHABILITATION METHODS AND STRATEGIES: Rehabilitation and retrofitting methods-repair options, performance requirements of repair systems, factors for selection of repair methods, Repair stages, Methods of repair including foundation rehabilitation methods, chemical and electrochemical method. Repair/Rehabilitation strategies - Stress reduction technique, repair and strengthening of columns and beams, Compressive strength of concrete, cracks/joints, masonry, foundation, base isolation. | |

**Text Books**

| S.N | Title | Authors | Edition | Publisher |
|---|---|---|---|---|
| 1 | Maintenance, Repair & Rehabilitation and Minor Works of Buildings | Varghese P.C. | 1st Edition | PHI Learning Private Ltd., New Delhi, 2014 |
| 2 | Concrete Technology | Santhakumar A.R. | 2nd Edition | Oxford University Press, New Delhi, 2007 |
| 3 | Handbook on Repair and Rehabilitation of RCC Buildings | CPWD (Central Public Works Department) | — | Govt. of India Press, New Delhi |

**Reference Books**

| S.N | Title | Authors | Edition | Publisher |
|---|---|---|---|---|
| 1 | Concrete Technology – Theory and Practice | Shetty, M.S. | — | S. Chand and Company, New Delhi, 1992 |
| 2 | Rehabilitation of Concrete Structures | Vidivelli, B. | — | Standard Publishers Distributors, New Delhi, 2008 |
| 3 | Maintenance and Repairs of Buildings | P.K. Guha | — | New Central Book Agency (P) Ltd., Kolkata |

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## THIRD SEMESTER

| Course Code | Course Name | Th | Tu | Pr | Credits | Evaluation | | |
|---|---|---|---|---|---|---|---|---|
| 25SE302T(i) | PE - IV Sustainable Construction and Demolition Engineering | 4 | - | - | 4 | CA | ESE | Total |
| | | | | | | 40 | 60 | 100 |

| Course Objectives | Course Outcomes |
|---|---|
| 1. To understand construction methods, planning, and demolition practices used in civil engineering projects.<br>2. To study construction equipment, scheduling techniques, and structural behavior during demolition.<br>3. To learn safety regulations, risk assessment, and protection measures in construction and demolition activities.<br>4. To understand waste management, recycling, and environmental aspects of construction and demolition works.<br>5. To develop knowledge of advanced construction technologies and sustainable construction practices. | At the end of the course, students will be able to:<br>1. Explain construction methods, demolition techniques, and planning procedures.<br>2. Select suitable equipment and scheduling techniques for construction projects.<br>3. Analyze structural stability and safety requirements during demolition operations.<br>4. Apply waste management, recycling, and environmental protection practices in construction projects.<br>5. Evaluate modern construction technologies and sustainable practices for efficient project execution. |

| **Unit I** | **[9 Hrs]** |
|---|---|
| **Introduction to Construction & Demolition:** Overview of construction industry, Types of construction projects (buildings, bridges, industrial)<br>Demolition: definition, scope, and importance, Life cycle of structures (construction → use → demolition) Sustainability in construction and demolition. | |
| **Unit II** | **[9 Hrs]** |
| **Construction Planning, Methods and Equipment:** Site investigation and preparation, conventional construction, precast construction, Pre-Engineered Buildings (PEB), formwork and scaffolding, construction equipment such as cranes, excavators and concrete mixers, basics of scheduling using CPM and PERT. | |
| **Unit III** | **[9 Hrs]** |
| **Demolition Techniques and Structural Aspects:** Manual demolition, mechanical demolition, implosion technique, deconstruction methods,factors affecting selection of demolition methods, behavior of structures during demolition, load redistribution, progressive collapse, temporary supports and shoring, stability during dismantling, protection of adjacent structures. | |
| **Unit IV** | **[9 Hrs]** |
| **Safety in Construction and Demolition:** Safety regulations and standards, hazards in construction and demolition such as falling debris, dust, noise and structural collapse, PPE, fire and electrical safety, safety planning and risk assessment. | |
| **Unit V** | **[9 Hrs]** |
| **Waste Management, Environmental and Legal Aspects:** Types of construction and demolition waste, waste minimization techniques, recycling of concrete, steel and wood, environmental impact assessment, sustainable demolition practices, environmental regulations, pollution control, legal permissions, documentation and compliance, green building concepts. | |

**Text Books**

| S.N | Title | Authors | Edition | Publisher |
|---|---|---|---|---|
| 1. | Construction Planning, Equipment and Methods | R.L. Peurifoy & Clifford J. Schexnayder | 8th Edition | McGraw Hill Education |
| 2. | Demolition: Practices, Technology and Management | V.A. Profillidis | 1st Edition | CRC Press |
| 3. | Construction Safety Management and Engineering | Darryl C. Hill & Brian H. Kleiner | 1st Edition | Pearson Education |

**Reference Books**

| S.N | Title | Authors | Edition | Publisher |
|---|---|---|---|---|
| 1. | Project Planning and Control with PERT and CPM | Dr. B.C. Punmia & K.K. Khandelwal | Revised Edition | Laxmi Publications |
| 2. | Building Failures: Diagnosis and Avoidance | B.A. Richardson | 2nd Edition | CRC Press |
| 3. | Handbook of Construction Management | Abdul Razzak Rumane | 1st Edition | CRC Press |
| 4. | Sustainable Construction | Charles J. Kibert | 4th Edition | Wiley Publications |

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## M.Tech. Scheme of Examination & Syllabus 2025-26

## STRUCTURAL ENGINEERING

### THIRD SEMESTER

| Course Code | Course Name | Th | Tu | Pr | Credits | Evaluation | | |
|---|---|---|---|---|---|---|---|---|
| | | | | | | CA | ESE | Total |
| 25SE302T(ii) | PE - IV Theory of Plates and Shells | 4 | - | - | 4 | 40 | 60 | 100 |

| Course Objectives | Course Outcomes |
|---|---|
| 1. To introduce the fundamental concepts of plates and shell structures, including geometry, co-ordinate systems, stress–strain relations, and equilibrium conditions.<br>2. To develop the ability to analyze thin rectangular and circular plates subjected to different loading and boundary conditions using classical plate theory.<br>3. To understand the structural behaviour and analysis of cylindrical shells using membrane theory and equilibrium equations.<br>4. To familiarize students with different shell forms, their classification, and various analytical methods used in shell analysis.<br>5. To provide knowledge of doubly curved and axi-symmetrical shells, including their geometry, analysis, and design applications in engineering structures. | The students will be able to<br>1. Explain the basic concepts of shell structures, shell coordinates, strain–displacement relations, and governing equilibrium equations.<br>2. Analyze thin rectangular plates under different loading and support conditions using Navier's and Levy's methods.<br>3. Evaluate the behaviour and stress distribution in circular plates subjected to symmetrical and concentrated loads.<br>4. Classify different types of shells and analyze cylindrical shells using membrane equations and Flugge's equations.<br>5. Analyze and design doubly curved and axi-symmetrical shell structures such as elliptic paraboloids, hyperbolic paraboloids, conoids, spherical shells, and cooling towers. |

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| **Unit I** | **[9 Hrs]** |
| Introduction: Space Curves, Surfaces, Shell Co-ordinates, Strain Displacement Relations, Assumptions in Shell Theory, Displacement Field Approximations, Stress Resultants, Equation of Equilibrium using Principle of Virtual Work, Boundary Conditions.. | |
| **Unit II** | **[9 Hrs]** |
| Small Deflection Theory of Thin Rectangular Plates: Assumptions – Derivation of governing differential equation for thin plates – Boundary conditions – simply supported plate under sinusoidal load – Navier solution – Application to different cases – Levy's solution for various boundary conditions subjected to different loadings like uniform and hydrostatic pressure. | |
| **Unit III** | **[9 Hrs]** |
| Circular Plates: Differential Equation for symmetrical bending of Laterally loaded circular Plates – Uniformly loaded circular plates – circular plate concentrically loaded – circular plate loaded at center | |
| **Unit IV** | **[9 Hrs]** |
| Shells – functional behaviour – examples – structural behaviour of shells classification of shells – Definitions – various methods of analysis of shells – merits and demerits of each method – 2D. Membrane equation. Equations of equilibrium: Derivation of stress resultants – cylindrical shells – Flugges simulations equations. | |
| **Unit V** | **[9 Hrs]** |
| Introduction to the shells of Double curvatures: Geometry, analysis and design of elliptic paraboloid, conoid and hyperbolic parabolic shapes, inverted umbrella type. Axi- Symmetrical shells: General equation - Analysis and axi-symmetrical by membrane theory. Application to spherical shell and hyperboloid of revolution cooling towers. | |

**Text Books**

| S.N | Title | Authors | Edition | Publisher |
|---|---|---|---|---|
| 1 | Theory of Plates and Shells | Stephen P. Timoshenko, S. Woinowsky-Krieger | 2nd Edition | Tata McGraw Hill |
| 2 | Analysis and Design of Concrete Shell Roofs | G. S. Ramaswamy | — | CBS Publishers & Distributors |
| 3 | Design of Concrete Shell Roofs | David P. Billington | — | Tata McGraw Hill, New York |

**Reference Books**

| S.N | Title | Authors | Edition | Publisher |
|---|---|---|---|---|
| 1 | Shell Analysis | N. K. Bairagi | — | Khanna Publishers, New Delhi |
| 2 | Design of Shells and Folded Plates | P. C. Varghese | — | PHI Learning Pvt. Ltd. |
| 3 | Design of Concrete Shell Roofs | Chatterjee | — | Oxford & IBH Publishing Co. |

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**THIRD SEMESTER**

| Course Code | Course Name | Th | Tu | Pr | Credits | Evaluation | | |
|---|---|---|---|---|---|---|---|---|
| | | | | | | CA | ESE | Total |
| 25SE302T(iii) | PE - IV Smart Structures and Application | 4 | - | - | 4 | 40 | 60 | 100 |

| Course Objectives | Course Outcomes |
|---|---|
| 1. To understand the concept and applications of smart materials and smart structures.<br>2. To study the characteristics and functioning of sensors and actuators.<br>3. To learn the principles and techniques of base isolation in structures.<br>4. To understand vibration control methods and energy dissipation techniques.<br>5. To develop knowledge of dampers and modern structural control systems for earthquake-resistant structures. | At the end of the course, students will be able to:<br>1. Explain the behavior and applications of smart materials and smart structures.<br>2. Identify different types of sensors and actuators used in structural systems.<br>3. Apply principles of base isolation for seismic protection of structures.<br>4. Analyze vibration control and energy dissipation techniques in structures.<br>5. Select suitable dampers and structural control devices for improving structural performance. |

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| **Unit I** | **[9 Hrs]** |
| **Smart Materials:** Introduction to smart structures, application, smart systems –Components of smart systems, different types smart materials – characteristics and behavior of smart materials – modeling of smart materials. | |
| **Unit II** | **[9 Hrs]** |
| **Actuators and Sensors:** Introduction of sensors and actuators., features and - characteristics of sensors-types of sensors and actuators-electronic, thermal and hydraulic type actuators, characteristics of sensors and actuators. | |
| **Unit III** | **[9 Hrs]** |
| **Base Isolation:** Theory of Base Isolation, Principle of base isolation, Methods, Techniques | |
| **Unit IV** | **[9 Hrs]** |
| **Vibration Controlled Techniques:** Energy dissipation devices; introduction, Methods, principals. | |
| **Unit V** | **[9 Hrs]** |
| **Energy Deissipation devices:** Dampers, purpose, Types of energy dissipation devices; Metallic yield dampers, friction dampers, viscoelastic dampers, tuned mass dampers. | |

**Text Books**

| S.N | Title | Authors | Edition | Publisher |
|---|---|---|---|---|
| 1. | Smart Structures: Analysis and Design | Srinivasan, A.V. and Michael McFarland, D. | 1st Edition | Cambridge University Press, 2000 |
| 2. | Smart Structures and Materials 2003 | Yoseph Bar-Cohen | 1st Edition | The International Society for Optical Engineering, 2003 |

**Reference Books**

| S.N | Title | Authors | Edition | Publisher |
|---|---|---|---|---|
| 1. | Smart Structures and Materials | Brian Culshaw | 1st Edition | Artech House, Boston, 1996 |
| 2. | Smart Materials and Structures | M.V. Gandhi and B.S. Thompson | 1st Edition | Chapman and Hall, 1992 |
| 3. | Basics of Structural Dynamics and Aseismic Design | Damodarasamy and Kavitha | — | PHI Publishers, New Delhi |